Development of Earthquake Prediction Public Policy

Michael Reichle
California Geological Survey

California Earthquake Prediction Evaluation Council

- Reviews earthquake predictions and provides other advice upon request by OES.
- Advises Director of OES on validity of a prediction for public policy purposes.

Activities of CEPEC over the years

- Review and evaluation
  - Automated aftershock probability statements
  - Possibility of an automatic statement following a magnitude M within 10 km of a specified fault.
- Review of Parkfield
- Review of Long Valley Plan Caldera

Activities of CEPEC over the years

- Rapid Review following an earthquake
  - Lake Elsman (1989)
  - Joshua Tree (1992)
  - Bombay Beach (2001)
  - Yucaipa (2005)

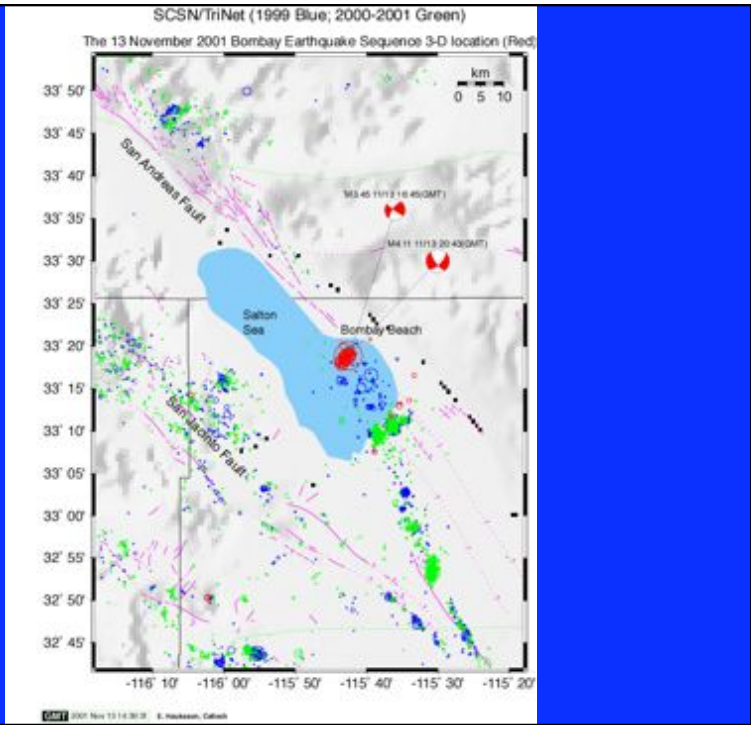
Lake Elsman Earthquakes 6/27/1989, M5.7

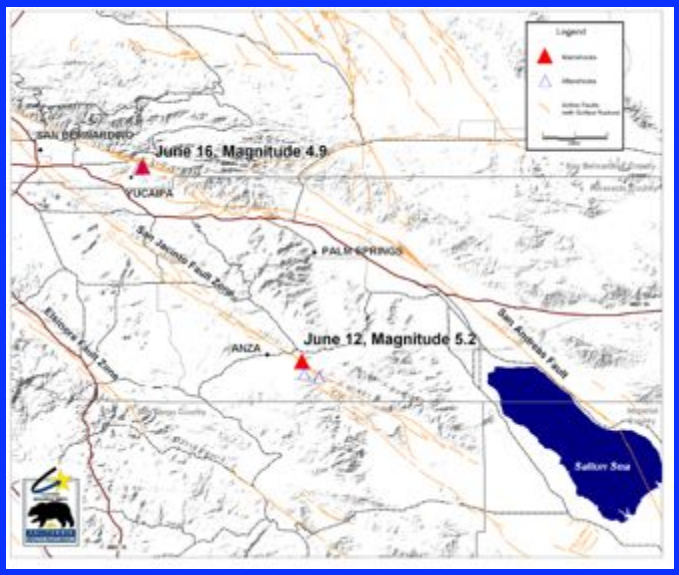
OES Advisory, after consultation with CEPEC:

"An increased likelihood exists for continued seismic activity for approximately five days. This activity could involve earthquakes as large as, or somewhat larger than, the Jund 27th earthquake, and could cause damage – particularly to older structures."

Joshua Tree Earthquake 4/23/92, M6.2

CEPEC principally concerned with loading of San Andreas fault, northern end of the Coachella segment. Aftershock seismicity approached and turned parallel to San Andreas.





Yucaipa Earthquake

"Historically, this has been a quiet area.

CEPEC felt this statement provided a sufficient statement of the probabilities as we understand them and decided not to provide additional comment beyond the aftershock probability statement already provided on the CISN and the STEP websites."

Activities of CEPEC over the years

- Evaluation of Specific Earthquake Predictions/ methodologies
  - Working Groups on Earthquake Probabilities
  - Quakefinder (2003)
  - Geoforecaster (2003)
  - Keilis Borok 1 (2004)
  - Keilis Borok 2 (2004)
  - STEP (2005)
  - John Rundle (2005)

Quakefinder

Private Venture relying on satellite-based observations of electromagnetic signals to explore the feasibility of earthquake prediction.

Quakefinder

CEPEC Commentary to OES on the Status of Understanding the Correlation between ELF Signals and the Occurrence of Earthquakes:

- There are known physical processes associated with earthquake occurrences that have the potential to generate observable ELF signals;
- The understanding of the extent to which these processes commonly generate strong ELF signals is an open question;
- The extent to which precursory and co-seismic ELF signals and earthquake occurrences have been documented is limited.

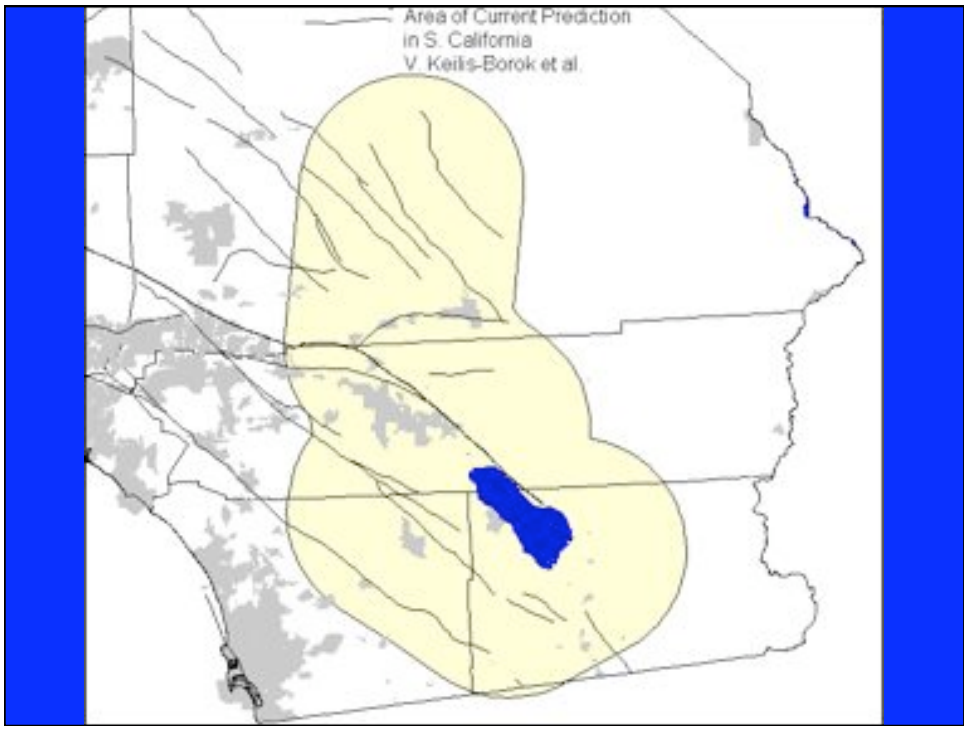
Quakefinder

CPEC Advises OES That:

- The current correlation between ELF signals and earthquakes is only tenuously established by comparatively few observations and should not be the basis for OES public policy.

Geoforecaster

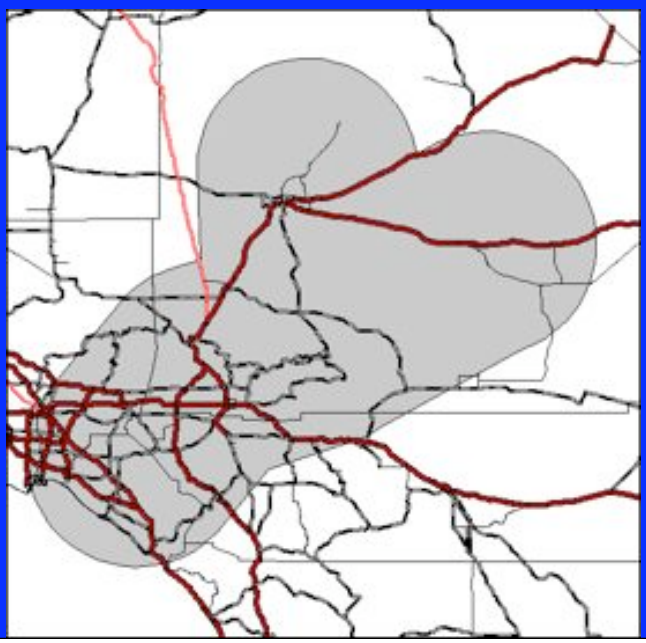
- Propietary methodology
- Cepec indicated an independent statisitcal analysis would be necessary to test geoForecaster predictions against random chance.
- Nothing provided to CEPEC suggested a basis for taking public policy action.



Keilis Borok 1

- The Keilis-Borok methodology appears to be a legitimate approach in earthquake prediction research. However, the physical basis for the prediction put forward by the authors has not been substantiated, and they have not yet issued enough predictions to allow a statistical validation of their forecasting methodology.
- This uncertainty along with the large geographic area included in the prediction (about 12,400 sq. mi.) leads CEPEC to conclude that the results do not at this time warrant any special public policy actions in California.

Keilis Borok Second Prediction Area



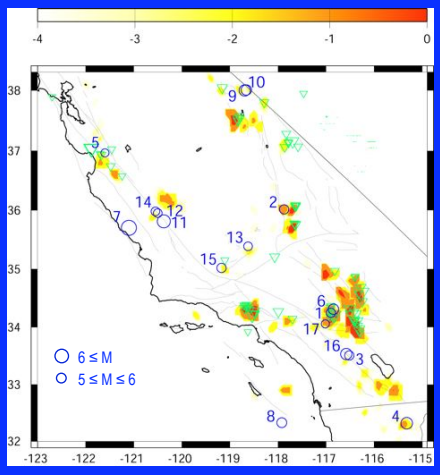
Keilis Borok 2

- To date there is no evidence that these, or related methods, yield useful intermediate term forecasts.
- Given that, and the track record so far, the Council does not consider the method to be a basis for public policy.

A Real Time Earthquake Forecast Experiment: Forecasting Locations of Future Significant Earthquakes 2000 - 2010

(JB Rundle et al., PNAS, v99, Supl 1, 2514-2521, Feb 19, 2002; KF Tiampo et al., Europhys. Lett., 60, 481-487, 2002; JB Rundle et al.,Rev. Geophys. Space Phys., 41(4), DOI: 10.1029/2003RG000135, 2003. http://quakesim.jpl.nasa.gov)

How are We Doing? (Composite N-S Catalog)



Plot of Log_{10} (Seismic Potential)

Increase in Potential for significant earthquakes, ~ 2000 to 2010

Seventeen significant earthquakes (blue circles) have occurred in Central or Southern California. Margin of error of the anomalies is +/- 11 km; Data from S. CA. and N. CA catalogs:

After the work was completed

1. Big Bear I, M = 5.1, Feb 10, 2001
2. Coso, M = 5.1, July 17, 2001

After the paper was in press (September 1, 2001)

3. Anza I, M = 5.1, Oct 31, 2001

After the paper was published (February 19, 2002)

4. Baja, M = 5.7, Feb 22, 2002
5. Gilroy, M=4.9 - 5.1, May 13, 2002
6. Big Bear II, M=5.4, Feb 22, 2003
7. San Simeon, M = 6.5, Dec 22, 2003
8. San Clemente Island, M = 5.2, June 15, 2004
9. Bodie I, M=5.5, Sept. 18, 2004
10. Bodie II, M=5.4, Sept. 18, 2004
11. Parkfield I, M = 6.0, Sept. 28, 2004
12. Parkfield II, M = 5.2, Sept. 29, 2004
13. Arvin, M = 5.0, Sept. 29, 2004
14. Parkfield III, M = 5.0, Sept. 30, 2004
15. Wheeler Ridge, M = 5.2, April 16, 2005
16. Anza II, M = 5.2, June 12, 2005
17. Yucaipa, M = 4.9 - 5.2, June 16, 2005

Note: This forecast was made using both the full Southern California catalog plus the full Northern California catalog. The S. Calif catalog was used south of lattitude 36°, and the N. Calif. catalog was used north of 36° . No corrections were applied for the different event statistics in the two catalogs. Green triangles mark locations of large earthquakes (M ≥ 5.0) between Jan 1, 1990 – Dec 31, 1999.

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John Rundle

- The Council made the following observations: (1) No physical basis or statistical test was given that PI does a better job of forecasting earthquakes than the RI method; (2) The low forecasting magnitude threshold of M5 limits the use of the methodology in public policy decisions; and, (3) No information was presented to demonstrate that methodology for M5 or greater earthquakes would apply to M6 or M7 and greater events.
- Council to concluded that the results of the forecasting methodology presented by Dr. Rundle do not at this time warrant any special public policy actions in California.